CLAIMS

1. An image distortion correcting apparatus for correcting distortion in an image displayed on a screen on the basis of a video signal, comprising:

a storage device for storing the video signal;

a write clock signal generation circuit for generating a write clock signal for writing an inputted video signal into said storage device;

a read clock signal generation circuit for generating a read clock signal for reading out the video signal stored in said storage device;

a distortion correction waveform generation circuit for generating a distortion correction waveform for correcting the distortion in the image by shifting the positions of pixels displayed on the screen on the basis of the video signal; and

a read clock signal control circuit for controlling the frequency of the read clock signal generated by said read clock signal generation circuit on the basis of said distortion correction waveform generated by said distortion correction waveform generation circuit,

said distortion correction waveform generation circuit setting said distortion correction waveform such that the amount of shift of the pixel reaches zero at both ends and

the center of the image in the horizontal scanning direction.

2. The image distortion correcting apparatus according to claim 1, wherein

said distortion correction waveform generation circuit comprises

a first correction waveform generation circuit for generating a first correction waveform which is changed in a horizontal scanning period of time,

a second correction waveform generation circuit for generating a second correction waveform which is changed in a vertical scanning period of time, and

a modulation circuit for modulating said first correction waveform generated by said first correction waveform generation circuit by said second correction waveform generated by said second correction waveform generation circuit, to obtain said distortion correction waveform.

3. The image distortion correcting apparatus according to claim 2, wherein

said second correction waveform has inflection points, the slope of at least one of a plurality of portions of said second correction waveform which are divided at said inflection points being variably set.

4. The image distortion correcting apparatus according to claim 2, wherein

said modulation circuit comprises a multiplication circuit for multiplying said first correction waveform generated by said first correction waveform generation circuit and said second correction waveform generated by said second correction waveform generation circuit.

5. The image distortion correcting apparatus according to claim 2, wherein

said modulation circuit comprises an amplification circuit comprising an input terminal receiving said first correction waveform generated by said first correction waveform generation circuit and a gain control terminal receiving said second correction waveform generated by said second correction waveform generation circuit.

6. The image distortion correcting apparatus according to claim 2, wherein

said first correction waveform corresponds to the change in the frequency of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the

right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, positive, zero, negative, and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, negative, zero, positive, and zero in this order, and

said second correction waveform is set such that the amplitudes thereof at the upper and lower ends in the vertical direction of the screen are larger than that at the center thereof.

7. The image distortion correcting apparatus according to claim 2, wherein

said first correction waveform corresponds to the change in the frequency of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, negative, zero, positive, and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, positive, zero,

negative, and zero in this order, and

said second correction waveform is set such that the amplitude thereof at the center in the vertical direction of the screen is larger than those at the upper and lower ends thereof.

8. The image distortion correcting apparatus according to claim 1, wherein

said read clock signal generation circuit comprises a phase-locked loop having a voltage-controlled oscillator for generating said read clock signal,

said distortion correction waveform generation circuit outputs said distortion correction waveform as a distortion correction voltage, and

said read clock signal control circuit superimposes said distortion correction voltage outputted by said distortion correction waveform generation circuit on an oscillation frequency control voltage of said voltage controlled oscillator of said phase-locked loop.

9. The image distortion correcting apparatus according to claim 2, wherein

said first correction waveform corresponds to the change in the period of time of said read clock signal, and is set such that in a case where the amount of shift of the

pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, positive, zero, negative, and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, negative, zero, positive, and zero in this order, and

said second correction waveform is set such that the amplitudes thereof at upper and lower ends in the vertical direction of the screen are larger than that at the center thereof.

10. The image distortion correcting apparatus according to claim 2, wherein

said first correction waveform corresponds to the change in the period of time of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, negative, zero, positive,

and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, positive, zero, negative, and zero in this order, and

said second correction waveform is set such that the amplitude thereof at the center in the vertical direction of the screen is larger than those at the upper and lower ends thereof.

11. The image distortion correcting apparatus according to claim 9, wherein

said read clock signal generation circuit comprises a phase-locked loop having a voltage-controlled oscillator for generating said read clock signal,

said distortion correction waveform generation circuit further comprises a conversion circuit for converting said distortion correction waveform obtained by said modulation circuit into a distortion correction voltage corresponding to the change in the frequency of said read clock signal, and

said read clock signal generation circuit superimposes said distortion correction voltage outputted by said distortion correction waveform generation circuit on an oscillation frequency control voltage of said voltage controlled oscillator of said phase-locked loop.

12. The image distortion correcting apparatus

according to claim 10, wherein

said read clock signal generation circuit comprises a phase-locked loop having a voltage-controlled oscillator for generating said read clock signal,

said distortion correction waveform generation circuit further comprises a conversion circuit for converting said distortion correction waveform obtained by said modulation circuit into a distortion correction voltage corresponding to the change in the frequency of said read clock signal, and

said read clock signal generation circuit superimposes said distortion correction voltage outputted by said distortion correction waveform generation circuit on an oscillation frequency control voltage of said voltage controlled oscillator of said phase-locked loop.

13. The image distortion correcting apparatus according to claim 8, further comprising a correction pulse addition circuit for adding a correction pulse to said distortion correction voltage in a horizontal blanking interval such that the average of the distortion correction voltage in each horizontal scanning interval of the video signal becomes a predetermined value.

14. The image distortion correcting apparatus according to claim 11, further comprising a correction

pulse addition circuit for adding a correction pulse to said distortion correction voltage obtained by said conversion circuit in a horizontal blanking interval such that the average of the distortion correction voltage in each horizontal scanning interval of the video signal becomes a predetermined value.

15. The image distortion correcting apparatus according to claim 12, further comprising a correction pulse addition circuit for adding a correction pulse to said distortion correction voltage obtained by said conversion circuit in a horizontal blanking interval such that the average of the distortion correction voltage in each horizontal scanning interval of the video signal becomes a predetermined value.

16. The image distortion correcting apparatus according to claim 13, wherein

said correction pulse addition circuit adds said correction pulse to said distortion correction voltage before the time point where phase comparison in said phase-locked loop is made in the horizontal blanking interval such that the average of the distortion correction voltage becomes a predetermined value for each horizontal scanning interval.

17. The image distortion correcting apparatus according to claim 8, wherein

said phase-locked loop further has a frequency divider for dividing the frequency of the read clock signal outputted from said voltage controlled oscillator, a phase comparator for comparing the phase of an output signal of said frequency divider and the phase of a predetermined reference signal, and a loop filter for smoothing an output voltage of said phase comparator and inputting the smoothed output voltage to said voltage controlled oscillator through an output node, and

said read clock signal control circuit comprises an emitter follower transistor having its base receiving said distortion correction voltage outputted by said distortion correction waveform generation circuit, and a capacitance provided between the emitter of said transistor and said output node of said loop filter of said phase-locked loop.

18. The image distortion correcting apparatus according to claim 8, wherein

said phase-locked loop further has a frequency divider for dividing the frequency of the read clock signal outputted from said voltage controlled oscillator, a phase comparator for comparing the phase of an output signal of said frequency divider and the phase of a predetermined reference signal, and a loop filter for smoothing an output

voltage of said phase comparator, and

said read clock signal control circuit comprises an addition circuit for adding said distortion correction voltage outputted by said distortion correction waveform generation circuit and an output voltage of said loop filter of said phase-locked loop and feeding a voltage obtained by the addition to said voltage controlled oscillator.

19. An image distortion correcting method for correcting distortion in an image displayed on a screen on the basis of a video signal, comprising the steps of:

generating a write clock signal for writing an inputted video signal into a storage device;

generating a read clock signal for reading out the video signal stored in said storage device;

generating a distortion correction waveform for correcting the distortion in the image by shifting the positions of pixels displayed on the screen on the basis of the video signal;

controlling the frequency of said read clock signal on the basis of said generated distortion correction waveform; and

setting said distortion correction waveform such that the amount of shift of the pixel reaches zero at both ends and the center of the image in the horizontal scanning

direction.

20. The image distortion correcting method according to claim 19, wherein

the step of generating said distortion correction waveform comprises the steps of

generating a first correction waveform which is changed in a horizontal scanning period of time,

generating a second correction waveform which is changed in a vertical scanning period of time, and

modulating said first correction waveform by said second correction waveform, to obtain said distortion correction waveform.

21. The image distortion correcting method according to claim 20, wherein

said second correction waveform has inflection points, and the step of generating said distortion correction waveform further comprises the step of variably setting the slope of at least one of a plurality of portions of said second correction waveform which are divided at said inflection points.

22. The image distortion correcting method according to claim 20, wherein

said first correction waveform corresponds to the change in the frequency of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, positive, zero, negative, and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, negative, zero, positive, and zero in this order, and

said second correction waveform is set such that the amplitudes thereof at the upper and lower ends in the vertical direction of the screen are larger than that at the center thereof.

23. The image distortion correcting apparatus according to claim 20, wherein

said first correction waveform corresponds to the change in the frequency of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the

left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is defined as zero, negative, zero, positive, and zero in this order, and the amount of shift of the pixel between the center and the right end is defined as zero, positive, zero, negative, and zero in this order, and

said second correction waveform is set such that the amplitude thereof at the center in the vertical direction of the screen is larger than those at the upper and lower ends thereof.

24. The image distortion correcting method according to claim 19, wherein

the step of generating said read clock signal comprises the step of generating said read clock signal by a phase-locked loop having a voltage controlled oscillator,

the step of generating said distortion correction waveform comprises the step of outputting said distortion correction waveform as a distortion correction voltage, and

the step of controlling the frequency of said read clock signal comprises the step of superimposing said outputted distortion correction voltage on an oscillation frequency control voltage of said voltage controlled oscillator of said phase-locked loop.

25. The image distortion correcting method according to claim 20, wherein

said first correction waveform corresponds to the change in the period of time of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, positive, zero, negative, and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, negative, zero, positive, and zero in this order, and

said second correction waveform is set such that the amplitudes thereof at the upper and lower ends in the vertical direction of the screen are larger than that at the center thereof.

26. The image distortion correcting method according to claim 20, wherein

said first correction waveform corresponds to the change in the period of time of said read clock signal, and is set such that in a case where the amount of shift of the pixel is defined as positive when the pixel shifts in the

scanning direction on the screen which is scanned from the left to the right, the amount of shift of the pixel reaches zero at the left end, the center, and the right end of the screen, the amount of shift of the pixel between the left end and the center is varied as zero, negative, zero, positive, and zero in this order, and the amount of shift of the pixel between the center and the right end is varied as zero, positive, zero, negative, and zero in this order, and

said second correction waveform is set such that the amplitude thereof at the center in the vertical direction of the screen is larger than those at the upper and lower ends thereof.

27. The image distortion correcting method according to claim 25, wherein

the step of generating said read clock signal comprises the step of generating said read clock signal by a phase-locked loop having a voltage controlled oscillator,

the step of generating said distortion correction waveform further comprises the step of converting said distortion correction waveform into a distortion correction voltage corresponding to the change in the frequency of said read clock signal and outputting the distortion correction voltage, and

the step of controlling the frequency of said read clock

signal comprises the step of superimposing said outputted distortion correction voltage on an oscillation frequency control voltage of said voltage controlled oscillator of said phase-locked loop.

28. The image distortion correcting method according to claim 26, wherein

the step of generating said read clock signal comprises the step of generating said read clock signal by a phase-locked loop having a voltage controlled oscillator,

the step of generating said distortion correction waveform comprises the step of converting said distortion correction waveform into a distortion correction voltage corresponding to the change in the frequency of said read clock signal, and

the step of controlling the frequency of said read clock signal comprises the step of superimposing said outputted distortion correction voltage on an oscillation frequency control voltage of said voltage controlled oscillator of said phase-locked loop.

29. The image distortion correcting method according to claim 24, further comprising the step of adding a correction pulse to said distortion correction voltage in a horizontal blanking interval such that the average of the

distortion correction voltage in each horizontal scanning interval of the video signal becomes a predetermined value.

30. The image distortion correcting method according to claim 29, wherein the step of adding said correction pulse comprises the step of adding said correction pulse to said distortion correction voltage before the time point where phase comparison in said phase-locked loop is made in the horizontal blanking interval such that the average of the distortion correction voltage becomes a predetermined value for each horizontal scanning interval.

31. An image distortion correcting apparatus for correcting distortion in an image displayed on a screen on the basis of a video signal, comprising:

storage means for storing the video signal;

write clock signal generation means for generating a write clock signal for writing an inputted video signal into said storage means;

read clock signal generation means for generating a read clock signal for reading out the video signal stored in said storage means;

distortion correction waveform generation means for generating a distortion correction waveform for correcting the distortion in the image by

shifting the positions of pixels displayed on the screen on the basis of the video signal; and

read clock signal control means for controlling the frequency of the read clock signal generated by said read clock signal generation means on the basis of said distortion correction waveform generated by said distortion correction waveform generation means,

said distortion correction waveform generation means setting said distortion correction waveform such that the amount of shift of the pixel reaches zero at both ends and the center of the image in the horizontal scanning direction.